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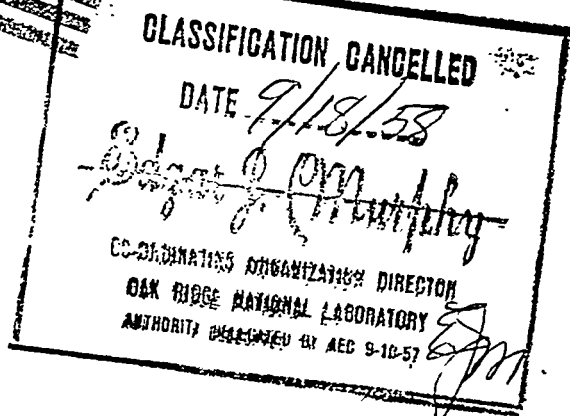
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at Oak Ridge National LaboratoryBy W. G. Stockdale, J. C. Suddath, W. K. EisterTo FileThis document has been approved for release
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THE CONTROL OF RADIOACTIVE AIR CONTAMINATION AT OAK RIDGE NATIONAL LABORATORY *

W. G. Stockdale, J. C. Suddath, W. K. Eister

Early in the Atomic Energy Program it was recognized that the operation of the nuclear reactor and the subsequent chemical processing of its products would cause large volumes of air to become contaminated with radioactive isotopes. The decision was made at that time to dispose of this radioactive contaminated air by discharging it from high stacks into the atmosphere. By this procedure sufficient dilution was obtained to control this hazard to the environment. Studies were carried out at the Metallurgical Laboratory in Chicago to determine the dilution of stack gases when discharged into the atmosphere^(1,2). Subsequently, the actual operation of these stacks at Oak Ridge National Laboratory was evaluated and found satisfactory^(3,4). In 1948, the presence of particulate matter in the air being discharged from the various stacks at ORNL was recognized, and the interest in the decontamination of air streams renewed⁽⁵⁾.

The major source of the particulate contamination in the air at ORNL was expected to be the air cooled nuclear reactor, and work was immediately initiated on the design of a system for cleaning this air. At the same time, a survey was undertaken to evaluate the contribution of all the potential sources in the Laboratory to this problem of particulate contamination⁽⁶⁾. The results of this study indicated that the large scale chemical processing at the Laboratory contributed more to the general area contamination than did the operation of the nuclear reactor. In addition, it was found that the amount of radioactivity contributed to the general atmospheric contamination from the laboratory hoods was relatively insignificant.

<u>Table I</u> <u>Determination of Potential Sources of Area Atmospheric</u> <u>Radioactive Contaminate</u>		
Source	Max. mc/m	Total mc/m
I ¹³⁵	1400	8000
RaLa	550	3300
Redox (100% HW)	0.6	150
Pile (before filter)	5.0	154
I ¹³¹ (after filter)		1
I ¹³¹	1.0	117
Hoods	0.01	2.3

* Report to the Los Alamos Meeting of the Waste Processing Group, October 6, 1950.

As a result of a literature search and consultation with companies concerned with problems of cleaning air, filtration was selected as the procedure to be used for cleaning the air from the nuclear reactor. Among the other techniques that were considered for this application were cyclone separators and electrostatic precipitators. The quantity of air required to cool the nuclear reactor is approximately 110,000 cfm. The air going into the nuclear reactor is filtered thru PL-24 American Air Filter. The air leaving the nuclear reactor, containing approximately 190 grams of dust per day, passes thru two filters - the first a roughing filter and the second a final cleanup filter. The roughing filter that is now in use consists of a half-inch of FG-25 plus a half-inch of FG-50 (American Air Filter). Originally it had been planned to use one inch of FG-50; however, subsequent tests show that the capacity of the filter could be greatly increased by using the 25-50 combination, without decreasing the filtration efficiently (7). The final cleanup filter is a CWS-6 filter. The air from the filters is discharged thru a fan to the 200 ft. stack used for discharging the pile cooling air into the atmosphere. The fan suction for this system is approximately 40 in. of water with approximately 8 in. of water pressure-drop allowed across the filter. The CWS-6 filter has now been in operation about 2 years. Its original pressure was 1 in. of water and this has now increased to about 3.3 in. The 25-50 filters are completely changed once every two years with 25% of them replaced every six months.

Table II			
<u>Evaluation of Filtering Efficiency</u> <u>of FG Material used in Pile Filter</u>			
<u>1/2"FG50</u>	<u>1/2"FG25</u>	<u>% Efficiency</u>	<u>Capacity</u>
2		100	100
	2	42	
1	1	100	354

A construction program is now underway at ORNL to replace the temporary facilities in which research and development is now carried out. This construction program is necessary to develop basic procedures for the ventilation of the working areas and the control of radioactive contamination in air. (8) It is proposed to reduce to a minimum the amount of air that has a possibility of becoming contaminated, and to classify radioactive contaminated air according to the degree of contamination and to prevent its dilution before treatment. The areas considered in this program were offices, laboratories, hoods, and cells.

These procedures are briefly summarized as follows:

Offices - six changes of air per minute, without treatment

Laboratories - minimum of ten changes of air per hour, without treatment

Laboratory hoods - 50 ft. per minute face velocity with provisions for the installation of the filter when demonstrated necessary. In addition, each hood will have two vacuum systems; the first system with 10 in. of water vacuum to draw the gases off of vessels containing high levels of radioactivity; the second system with 20 in. of mercury vacuum will be used for solution transfers and other applications where high vacuum is required. The air from both of these vacuum systems will be cleaned before discharged to the atmosphere.

Cell - held at reduced pressure (1 in. of water), when contamination is anticipated, air flow limited to about 250 cfm which will require the air to be cleaned. When cell air contamination is not probable, 20 changes of air per hour, without treatment. There are two vacuum systems in the cells; 40 in. of water vacuum to be used for dissolver and process vessel off-gas line, and 28 in. of mercury vacuum to be used for solution transfers and high vacuum applications. The air from both vacuum systems will be treated.

A central facility has been established at ORNL to clean the radioactive contaminated air from the chemical processing areas and to dispose of it to the atmosphere. The air from the cell and hood vacuum systems is cleaned by passing thru a Cottrell electrical precipitator followed by an FG - 25 - 50 filter. This system has a capacity of about 2000 cfm. The Cottrell electrical precipitator is of the exposed tube type containing 23 pipe, 8 in. in diameter and 12 feet long. It is constructed of stainless steel and has continuous flush system installed. Preliminary tests have indicated that when operated dry the maximum voltage is approximately 52,000 volts, a current of 130 milliamper. A flow of 30 gal. of water per minute is required to thoroughly flush the equipment and with this rate of water flow, the maximum voltage is 30,000 volts with current of 20 milliamperes. The second air cleaning facility in this area is on the cell air from the old isotopes production area and uses Trion high efficiency electronic gas filters followed by the FG-25-50 and CWS-6 filters.⁽⁹⁾ Trion units with individual capacities of about 800 cfm are constructed of stainless steel and have an applied voltage of 7,000 to 8,000 volts with a current demand of 30 milliamperes. This unit has been tested to determine the effect of flow rate on the percent removal and pressure drop. When the flowrate was varied from 600 to 1100 cfm, the

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percent removal reduced from 94 to 92%, with the pressure drop increasing from 0.06 to 0.283 into the water. When the flow rate was increased to 1600 cfm. the percent removal was reduced to 82% with the pressure drop being increased to 1.1 in. of water. A third system brings the air from the hoods into the radioisotopes production area to the stack where it is discharged without treatment.

In addition to the local responsibility for radioactivity air control, ORNL is also responsible for this system at the Idaho Chemical Processing Plant. The same basic procedures will be applied to the Idaho Plant. While the complete detail of the system has not been worked out, it is planned to filter all the incoming air to the plant and to discharge the gases from a 250 ft. stack that will be located at approximately 400 feet from the building. The filters will probably be used on the high level radioactive contaminated air with provisions for iodine removal, and perhaps xenon and krypton removal.

Work is to continue at Oak Ridge National Laboratory on two phases of the air decontamination problem. The first phase of the program will be concerned with the reduction of the quantity of air that has the opportunity of becoming contaminated. The second phase of this program will be concerned with the evaluation of alternate air decontamination procedures with the ultimate object of decreasing the cost of air decontamination.

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